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Soil Conservation

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Soil Conservation
25 Years Ago

"Conservationists may well ponder and study the agriculture of Peru in its development of crop plants and in the adaptation of sustained land use to steep, mountainous slopes. . . .

"The fertility of the alluvial soil in the valley bottoms, frequently renewed by deposits of mud from the streams in flood, must have encouraged the development of continued agriculture with crop production year after year on the same lands. The spreading of water from the streams onto land it would not otherwise reach, as was evidently done before the Inca times—probably A. D. 1000—not only made it possible to raise crops during times of little or no rainfall but assisted in maintaining the fertility of the soil on those areas also. As population increased, more and more land was so irrigated, streams were narrowed and straightened by the construction of stone walls, and terraces with stone retaining walls, likely used first in valley bottoms as a means of holding soil during floods, were extended farther and farther up the slopes."

COVER PICTURE.—Soil and water management to live by marks the 220-acre, contour stripcropped farm of Ray Hecksel near Watertown, Minn. The marshy area at the right is reserved for wildlife—pheasants, ducks, and some deer—and Oak Lake in the foreground provides boating and other recreation.—Photo by Erwin W. Cole.

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Soil Conservation

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FRANK B. HARPER, Editor

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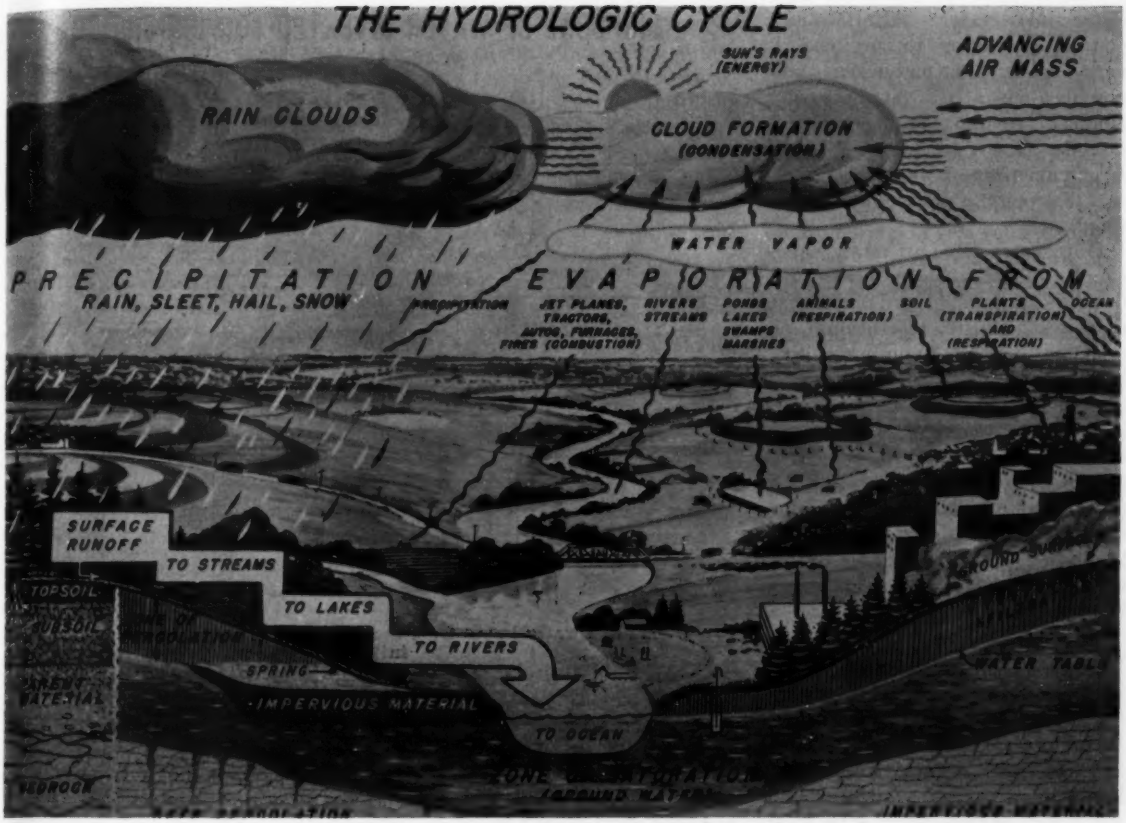


OUR UNSEEN WATERS

By Donald A. Williams

THE vast distribution of our life-giving waters out of sight in the soil and deeper underground is brought home to us in the above illustration of the hydrologic cycle. It confirms again the principle that soil and water conservation are inseparable.

An average of 30 inches of water falls on the land in the United States as rain or snow, though the amount obviously varies—from 120 inches in parts of the Pacific Northwest, for example, to less than 5 inches in areas of the arid Southwest. But nearly three-fourths of our average water received—21 inches, or 70 percent—is evaporated from the surface, or is transpired by plants from the water that disappears into the ground.

Eight of the 30 inches of water finds its way to the ocean, mainly by way of surface streams; and 1 inch is used up by agriculture and industry in its journey from land to sea. These figures, again, vary widely, as determined by climatic, soil, land-use; and other conditions in a particular location.

When we think about it at all, many of us think of the water we can see and feel. We are concerned with the water we have at hand to use for our personal drinking and other needs; for recreation; for irrigating farm crops, our lawns, and our gardens; or for electric power generation and other uses. Yet, we depend first of all upon water stored in the soil to produce our essential food crops, grass for livestock and wild game, and timber for shelter and other purposes.

Amounts of soil water used by a crop or other plant vary, of course, under different climatic, soil fertility, and other conditions; but the following estimates point up the fact that the demands by growing vegetation on our unseen

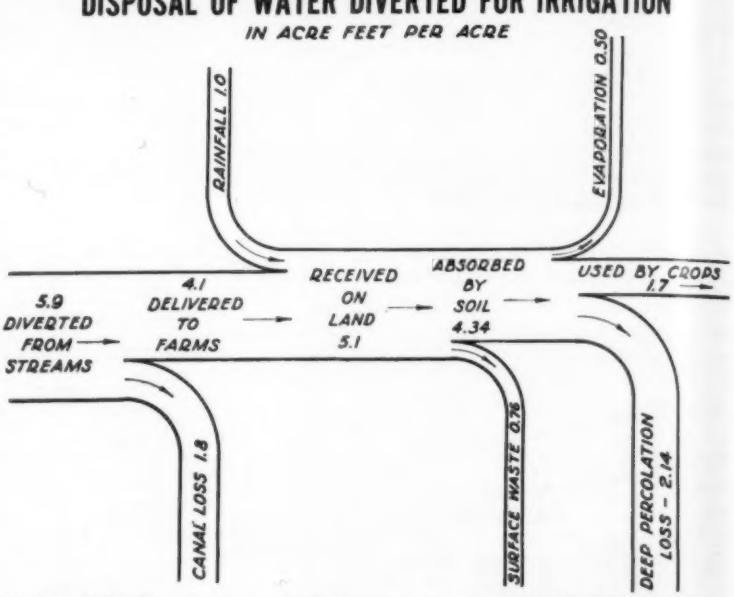
The author is administrator, Soil Conservation Service, Washington, D. C.

water are major: Alfalfa, 850 pounds of water to produce 1 pound of dry matter; wheat, 505 pounds; corn, 372 pounds; sorghum, 271 pounds; and cotton, 562 pounds. Trees likewise use even larger amounts of water—as much as 1,000 pounds per pound of dry wood.

How much of our total water supply is available for crops and livestock, municipal and industrial purposes, wildlife, recreational, or other use depends upon our ability to intercept the precipitated water as it moves endlessly to the ocean in surface streams or through the soil and underground in the course of the hydrologic cycle. It is the amount of available, usable water that counts, and that depends upon the insoak and runoff of each watershed. Water management, then, begins with land management.

Sixty percent of the Nation's land area is in farms and ranches, interspersed in the West, principally, by public forest and grass lands. It follows that most of our water falls on farm, ranch, and forest lands. How farmers, ranchers, and woodland owners deal with that vast land surface accordingly determines in large measure the quality and quantity of water that will be available for American agriculture, for rural areas and urban, for industry, for wildlife, or for recreation. It is on these agricultural watersheds, including their associated mountain divides and public lands, that the destiny of our water supply and land resources is being worked out.

It is there—through farmers' soil and water conservation districts, community watershed organizations, and other local means—that modern techniques of sound water conservation, management, and use as related to farm, forest, and other lands are being employed so effectively. This with technical, cost-sharing, and other assistance of the Soil Conservation Service and other U. S. Department of Agriculture agencies in cooperation with all local, State, or Federal agencies or private interests concerned.



Canal and ditch water losses from seepage are more than 50 percent in many instances.

With our growing population and increasing per capita use of water, we have to think in terms of maximum use of all the water we have, some of it not once but many times over. Water use in the United States, exclusive of that used to generate power, amounted to 240 billion gallons a day in 1955, as recorded in the 1959 report of the Senate Committee on National Water Resources. This report, which for the first time provided us with a really comprehensive national look-ahead at our water resources and needs, said water usage could be expected to be nearly double in 20 years and triple by the year 2000.

Significantly, the report showed 20 percent of the 240 billion gallons used in 1955 was ground water. Still more significant are such findings as that ground water was removed in 1958 from 25,000 acres in the High Plains of Texas and New Mexico 140 times faster than it was being replenished.

Soil and water conservation measures are proving their ability uncounted times over to mitigate waste or depletion of surface, soil, and ground water alike. They work together to make water available where it is needed on field, farm, and watershed in amounts needed, when it is needed. Thus grass and legumes in crop rotations, contour tillage, grazing rangeland within the sustained carrying capacity of the grass, and similar management and use of woodlands all help to hold water in the soil for optimum plant growth.

One of the major contributions of conservation to husbanding our water supplies is through improvements in the efficiency of handling irrigation water. Agriculture makes approximately 60 percent of the total "withdrawals" of water from streams, lakes, and wells for all economic users. Because of this most agricultural water is used for irrigation, and because a high percentage of irrigation water is evaporated or used in building plant tissue, agriculture accounts for

nearly 95 percent of the "consumptive use," or disappearance, of available water supply.

Studies by the Agricultural Research Service and the Soil Conservation Service show that, in the absence of conservation irrigation practices, sometimes only 25 to 50 percent of the water withdrawn is made available for crop growth. By contrast, conservation irrigation systems installed according to standards in use in soil conservation districts regularly attain efficiencies of 60 to 70, and sometimes 80, percent.

These water-conserving measures include irrigation farmers' adjustment of cropping plans in accordance with the amount of snow water forecast for the season's streamflow and reservoir storage, land leveling to obtain better use of water in the fields, lining ditches to cut down on water seepage through earthbanks, improved drainage to prevent too high water tables that result in waterlogging and salt accumulation, and re-use of water through on-the-farm storage and groundwater recharging devices.

The most spectacular contributions to efficient and orderly utilization of our water supplies for agriculture and our other everyday uses are in the rapidly spreading watershed protection and flood prevention treatment and management of the Nation's approximately 8,000 small watersheds shown by the Conservation Needs Inventory to be of a size suitable and needing project action for one or more purposes. The needed projects would embrace nearly a billion acres, or half the land area of the United States.

A watershed that is adequately protected by vegetation, or by other soil and water conservation measures on the land, and by small dams or other structures to slow down the flow of surface runoff water, also more nearly assures the availability of soil water and ground water where and when it is needed, both upstream and downstream. The water intake by the watershed soils is stabilized at the optimum rate needed by trees, grass, or cultivated crops, and to maintain water supplies for springs, stockwater ponds, and upstream reservoirs. At the same time, there is a more even and dependable flow of underground water down the watershed to supply water to major downstream reservoirs and to meet irrigation or other water needs at the lower end of the watershed.

In the East or in the West, water problems are, in the last analysis, watershed-wide problems. Landowners and other water users at the upper end of the watershed and those at the lower end all are affected by what happens to the water of the whole watershed, and accordingly have a common stake in its treatment and use.

The Soil Conservation Service recognizes this fact and seeks the ultimate possible balance, consistent with technical soundness and the requirements of State laws and other directives, in its farm and watershed assistance. To this end, it employs specialists in hydrology and geology, in addition to soils, plant materials, engineering, and other technical people.

The facts show that as a Nation we can meet our water needs. We can avoid "water bankruptcy," just as we have been able to cope with the menace of soil erosion. But to do so, we need to move ahead with the concerted efforts in management of our water—above ground and below ground.

Palouse Farmer's Alfalfa-and-Grass Saves Moisture—Controls Erosion

By Stanley Bannister

ALFALFA-and-grass is king in the water saving and erosion control crop rotation used by George Gault on his dryland farm in the eastern Washington Palouse.

That was not the case, though, when he took over his father-in-law's farm and attended 1947 group meetings sponsored by supervisors of the Central Whitman Soil Conservation District, at which a Soil Conservation Service technician explained how farmers in the Palouse country could deal with their problem of costly soil losses.

Each year during spring runoff, the little trickle that people called the Palouse River became a mud-toting giant. The villain in this annual tragedy—according to the technician—was the time-honored practice of summer fallow, in which 2 years were required to produce one wheat crop.

Stubble burning still was practiced on many fields, where the ground then was worked fine and clean like a garden. The wheat, usually planted in the fall of the second year, seldom grew dense enough to protect the overworked soil from slashing winter rain-

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storms and snowmelting "chinooks." Water that couldn't soak into the ground torrented down the long, steep slopes, frequently carrying 50 tons of topsoil an acre with it on its way down myriad gullies into the small bottom-land streams.

A college graduate and a chemist by profession, Gault was challenged by the thought that each year Nature dropped an average of 18 inches of moisture on the land which he planned to farm. If he could catch that water and put it to good use, he could grow a paying crop each year on every acre. But, to make good use of that water, he knew that he also would have to provide a good balance of water-soluble plant foods.

Looking around on other district farms operated under conservation plans, he saw that rough tillage and good, fibrous plant residues helped the earth sop up water. He also liked a legume's built-in "chemistry lab," and understood that effective conservation rotation had to be centered around grass and legumes.

The spring of 1947, he planted a field to sweetclover and grass; and, as he acquired a few head of Hereford cattle, he started alfalfa and grass. After 6 years, when sweetclover got too many sicknesses to grow well in the Palouse, he switched completely to alfalfa and grass. That meant more cattle.

"It was my Scotch ancestry," he explained. "I just couldn't see all that good forage go to waste."

Today, the Gault herd has grown to 60 cows. One hundred and fifty acres of alfalfa and grass supply them weight-producing hay and pasture the year around. After a summer's grazing, there is still plenty of top growth to protect the hilly land from erosion.

George Gault, Jr., inspects rough-plowed seedbed with James Hansen of SCS.

Gault likes alfalfa in his rotation for several reasons: It adds humus and nitrogen to the soil for later crop use. It has long, tough roots that bring up minerals far below the reach of ordinary plants. Those roots also are efficient subsoilers which prepare the ground for penetration by the weaker roots of cash crop plants.

"I buy lots of nitrogen fertilizer," Gault explains. "But I find that after alfalfa-and-grass has been grown, the land is always more responsive to applications of commercial fertilizer than it was before."

His rotation is flexible, so crops grown can be geared to fluctuating market needs. A typical rotation might go 9 or 10 years. To keep from too much costly fence moving, he usually leaves alfalfa-and-grass 5 years before plowing it out. Then he makes sure he has a cloddy seedbed that leaves the ground like a giant sponge waiting to sop up the winter rains and trap wind-drifted snow.

For these and other good farming practices, Gault was named "Mr. Conservation Farmer" of the Central Whitman Soil and Water Conservation District in 1952.

Gault's Hereford cattle thrive on this Ladak alfalfa and intermediate wheatgrass pasture.

WATER—

The "Stuff That Keeps Them Going"

By Warren J. Brown

1961.—Old wood and metal Tovera flume before being replaced.

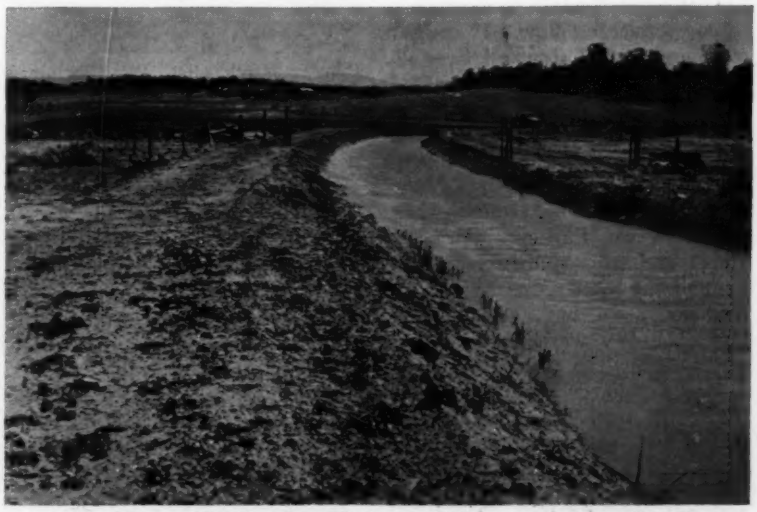
THE people of Pine River Valley in southwestern Colorado look on water as the "stuff that keeps them going."

Water from the river keeps the earth green in summer, makes hay and pasture lands produce, and furnishes highly valued recreation and family enjoyment. But to the people who use it in the valley, water seems to grow scarcer year by year; and each year it accordingly becomes more and more precious to them. That is why the business of conserving the water supply from the melting winter snows in the high mountains, and making it perform its services more efficiently as it passes downstream, is growing in importance.

And that is why the Pine River Soil Conservation District has assigned top priority to water conservation and proper irrigation water management. Irrigation farmers are being urged to replace wornout wooden structures with permanent, efficient water-saving systems and devices. The district board's objective is to put every drop of the supply to efficient conservation use.

The board arranged with a Colorado Springs supplier to furnish needed pipe, headgates, and Parshall flumes at a saving to the local farmers. The rate of installation has increased five or six times. The water-conscious irrigation farmers are becoming increasingly aware of the importance of accurate measurement of the water they apply to their fields, and find the flumes to be a useful measuring device.

During the summer of 1961, Aaron Harper replaced a wooden flume on his farm with a modern concrete siphon. When it was completed and working, Harper said: "It sure is good not to worry about



1962.—Dike carries Morrison Ditch over 60-in. concrete undershot pipe.

The author is work unit conservationist, Soil Conservation Service, Ignacio, Colo.

the old flume falling down!"

During the same period, the Pine River Canal Company asked the district for advice in replacing the flume across Sambrito Creek. The flume appeared to be about to fall, and it was wasting water. The district proposed a concrete siphon, which was installed by a New Mexico firm and already has brought a substantial saving in water for users downstream.

The Morrison Consolidated Ditch Company asked the district for help in planning a structure to replace its Tovera flume. Soil Conservation Service engineers recommended an undershot and compacted earthfill. The structure was completed the summer of 1962, and is reported by Robert Klusman, a company official, to be satisfactory.

Rodney Pargin, a Pine River farmer and a supervisor on the soil conservation district board, pointed out that the district has much still to accomplish in the conservation of water in the area.

"But the progress we have made is encouraging," he said. "Everyone is working enthusiastically with the board in reaching our goal."

Kickapoo Conservation Orchards Bring People and Money To Valley

By Robert E. Lee and Arthur J. Amundson, Jr.

CONSERVATION management is helping the ridgetop orchards along the Kickapoo River valley in western Wisconsin better fill their role in development of Crawford County's resources.

Thanks to such land-use measures as sod cover and contour tree planting, flash floodwater no longer strips away topsoil and cuts raw gullies in the orchard area; and today these orchardlands contribute little runoff or silt to the river's often rampaging flow. The eight commercial orchards all are cooperating with the Crawford County Soil and Water Conservation District, through which Soil Conservation Service technical help is available.

There was a time, though, when things were different. As Jim Kegel, orchardist and lifelong resident of the county, recalls: "I remember, as a boy, seeing man-sized boulders washed out of the gullies below the orchards."

Early orchards were clean tilled under the trees, and annual crops of potatoes, oats, or, in some cases

Pioneer Orchardist Ben Twining's daughter, Leita Twining Slayton, and Jim Kegel at marker above Gays Mills commemorating establishment of Kickapoo orchards.

strawberries, often were planted. In many instances, clean cultivation was complete. The land was disked several times each season. As a result, the oldest orchards still have trees growing on mounds —evidence of the soil lost in earlier days.

Present-day management includes permanent sod cover in all the orchards. Rather heavy fertilization also is done regularly. Most of the orchards planted since 1955 are laid out on the contour. As these changes to conservation land use took place, the land became more able to soak up the thunderstorm rains. Gullies became inactive and are gradually healing—occasionally with the help of a bulldozer. No longer are raw rock washes moving boulders down to the valley below.

Meanwhile, annual production of apples in the Kickapoo orchards averages some 300,000 bushels, with a peak potential estimated at 400,000 bushels. Roadside sales account for an average of 25 percent of the apple crop, with some orchardists reporting as high as 60 percent sold in this way. Wholesale outlets are mainly in Milwaukee, Chicago, and St. Paul, and there is another substantial market for Kickapoo apples in Winnepeg, Canada.

Thousands of people tour the orchards each spring to see the snowy bloom; and every fall more people come to Gays Mills for the apple festival sponsored by the Lions Club. The extent of the tourist business created by the orchards is hard to establish precisely, but the local economic impact clearly is considerable. Moreover,

The authors are area conservationist, La Crosse, and work unit conservationist, Gays Mills, both of the Soil Conservation Service, Wisconsin.

James Fleming's contoured orchard with sod cover makes for easier use of such heavy equipment as this 4-ton power sprayer unit.

25 people have full-time employment in the local orcharding operations, and several hundred are employed in picking, sorting, and packing in the season.

Other fruit crops — cherries, raspberries, grapes, and some pears —are raised in the area, but usually not in commercial quantities. Cherries, for example, are sold on a "pick-your-own" basis. Each spring, hundreds of post cards are sent to out-of-State and other customers advising them of cherry-picking dates.

Success of the Kickapoo apple orchards, in which some of the trees are 45 years old and still producing, may be credited in no small measure to the enterprise of two early promoters of the development. They were John Hays, an officer of the Wisconsin Horticultural Society, and Ben Twining, who was to be elected one of the supervisors when the Central Crawford Soil Conservation District was formed in 1938. In 1905, they collected apples from 8 or 10 farmers in the Gays Mills area and exhibited them at the Wisconsin State Fair, where they were awarded first prize. These same apples again won first prize for the Horticultural Society, at a national apple show in New York.

These and other experiences led the Wisconsin Horticultural Society to push commercial production, with establishment in 1908 of a 5-acre State trial orchard. Some of the original trees still remain on this land, now owned by Kegel. In 1911, an organization was formed in Gays Mills which successfully promoted the establishment of orchards through two companies. By 1916, there were 800 acres of apple trees and 100 acres of cherries and plums. Today, the acreage in productive orchards is only slightly higher, but includes more apple trees.

Records of the Crawford County district show 216 acres of contour orchards, to complement its 60,000 acres of contour strips on surrounding cropland. More of the land can be used safely for orchard planting when rows are on the contour, because there is less of a hazard for equipment operation.

Contour rows also prevent getting stuck with heavy sprayers, and have done away with the deep corners that used to exist with the old square system of planting. A system of roadways following the ridge tops connects all contour rows and provides high, dry, and gently sloping grades easy to negotiate, even with a heavy load of fruit.

Five-year-old Fleming orchard entirely on the contour provides appropriate background for "Orchard View" School.

•

Oklahoma State University research indicates that ultraviolet light is satisfactory for the disinfection of water supplies from a farm pond filter installation. A 30-watt ultraviolet light unit would control normal contamination effectively at a 2-gallon-per-minute waterflow.

"Bedded" Lands Solve New Yorker's Hay Problem

By Charles B. Woodruff, Jr.

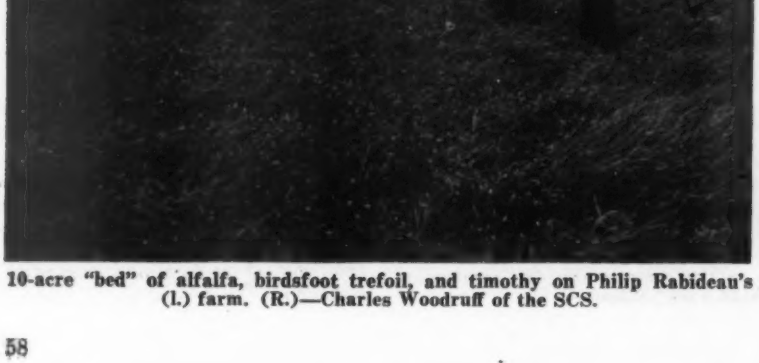
A SYSTEM of "lands" or "beds" with water interceptor and conductor ditches has assured Philip Rabideau in New York's Clinton County Soil Conservation District good hay crops while repaying the $80 an acre cost of the conservation improvement in 2 years.

Rabideau is one of several "north country" farmers along the shores of Lake Champlain and adjacent areas whose "bedded-lands" are producing up to 5 tons of bromegrass, alfalfa, and birdsfoot trefoil mixtures to the acre. The same kind of soil across the interceptor ditches do well to yield 1½ tons of poor grass.

More than 200 acres of clay and clay loam soils situated on the more level land, where outlets are at a premium, have been established on farms using the interceptor and surface ditch system in Clinton County since its start in 1957. Plans are to expand it in the "north country" rural area counties of New York State. Additional refinements, such as the use of the landplane or land leveler, are being made through research and actual use.

Rabideau grows corn for silage, oats, and forage crops consisting mostly of alfalfa, timothy, and birdsfoot trefoil on his 194-acre dairy farm east of Chazy. Back in 1958, when he first contacted the district about his excess water problem, he was growing only oats on this land—"and poor oats at that." He usually was late getting on the land, and in wet years couldn't get the oats harvested.

The Soil Conservation Service helped Rabideau establish the system, first surveying the area and making a contour map to determine the slope. A system of mains, interceptor, and conductor ditches was laid out to drain into a nearby line-ditch outletting into Lake Champlain.



10-acre "bed" of alfalfa, birdsfoot trefoil, and timothy on Philip Rabideau's (l.) farm. (R.)—Charles Woodruff of the SCS.

The interceptor and conductor ditches have an average depth of 2 and 3 feet with 8:1 side slopes, and the "beds" are 1½ feet from the crown to the channel of the surface ditch. Each "land" is 85 feet wide and between 800 and 1,000 feet long. The beds make it possible for Rabideau to grow grass forage mixtures on land that usually was too wet to grow anything but sedges and native grasses. It also is possible to grow an open-tilled crop, such as corn, in the first year of a rotation followed by a grain seeded to a forage crop.

A total of 6,800 feet of interceptor, conductor, and surface ditches were installed in the spring of 1958, and 13,280 feet built in 1959 completed the initial layout. The new "beds" were harrowed five times lengthwise and two times across, followed by final smoothing with a spring tooth harrow. Half of the construction costs were cost-shared through the Agricultural Conservation Program.

Rabideau planted Narragansett alfalfa, birdsfoot trefoil, and timothy on most of his 25 bedded acres, and has seen a slight increase in his hay yields each year since establishment in 1958. He claims his Narrangansett alfalfa did much better than the birdsfoot trefoil, and last year replanted some of his "beds" to Narragansett alfalfa and timothy. He uses an oats nurse crop the first year.

In the 1962 drought, when many Clinton County farmers were wondering what they were going to use for hay during the winter, Rabideau's alfalfa averaged 2 tons to the acre on the first cutting. Excess rain later, however, caused some lodging and other damage in

The author is work unit conservationist, Soil Conservation Service, Plattsburgh, N. Y.

his oats and forage crops.

His management includes applying 400 pounds of 8-16-16 fertilizer and liming at planting time, and topdressing every other year with 200 pounds of 0-15-30 per acre. He always goes into the winter with 6 to 8 inches of growth on his alfalfa, and some years with considerably more.

Rabideau has found that his "bedded land can be worked earlier than before," and that "cut hay dries quicker following a rain on land that has been terraced." His heavier soils are more friable, and the hardpan is broken to a point that roots go down deeper. Even the turned up subsoil seems to produce better, especially alfalfa. Rabideau likes this system of water management so well after about 6 years that he plans to extend it to his remaining 30 acres.

Rank growth of second cutting of alfalfa and timothy on bedded land.

Our Soil-Moisture Reservoir

By Cecil H. Wadleigh

ALTHOUGH most of the Nation's growing concern over its water resources is centered on lakes and reservoirs and underground aquifers the production of our basic needs such as food and fiber and wood products actually derives from the soil's capacity to supply water to meet evaporative demands on vegetated lands.

On an average day, water in the root zone amounts to about 650 million acre-feet. Thus, water held in the soil-moisture reservoirs at a given time is nearly equal to one-half the total annual flow of the Nation's streams—about 1,370 million acre-feet, or about 29 percent of average annual precipitation. Because about 3,380 million acre-feet of water—71 percent of our water budget—is used annually in evapotranspiration from fields, forests, and rangelands, the soil-moisture reservoirs must be recharged the equivalent of five or more times during the average year.

Management of soil-moisture reservoirs not only is a key determinant in the production of man's basic needs, but also is a significant determinant as to beneficial use of the major portion of the Nation's water budget. The soil acts as a sponge and retains water against the downward pull of gravity. This retained moisture enables plants to use water and grow between rains or irrigations, and to survive during protracted droughts.

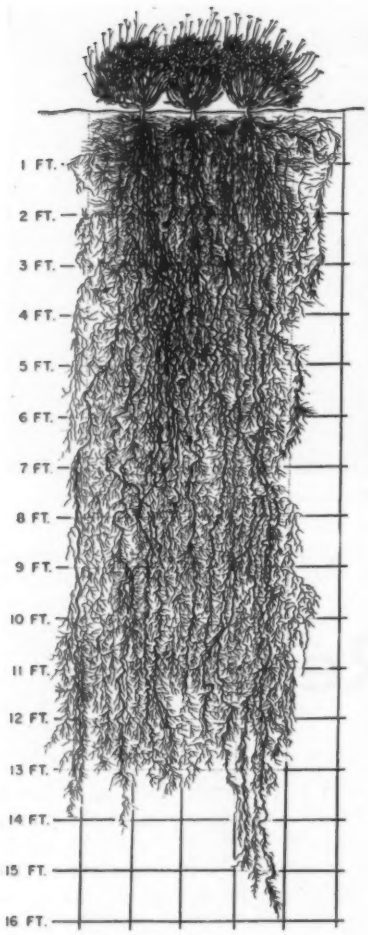
However, there is an important difference between a surface reservoir and the soil. Water in a conventional reservoir is free to run to the pump inlet and moves there more rapidly than the pump can extract it. Water in the soil is not completely free to move to the absorbing roots, and it may move much more slowly than the plant roots can remove it. Thus, use of the water in the soil-moisture reservoir is dependent on growth and proliferation, or multiplication, of the roots—the "pump"—to reach moisture films absorbed on the surface of soil particles.

The availability of the soil moisture is limited by the depth of the rooting zone and the supply of available water per foot of depth. A sandy soil may hold less than 1 inch of available water per foot of depth; whereas a clay loam may hold 2½ inches. Thus, a crop with roots penetrating but 1 foot in a sandy soil would have a moisture reservoir of only 1 inch of water;

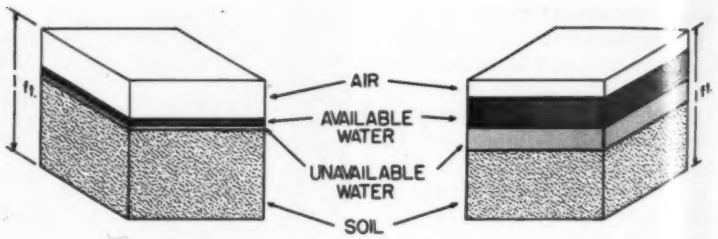
No. 72

This is the seventy-second of a series of articles to appear from time to time in explanation of the various phases of research being conducted by the Department of Agriculture on problems of soil and water conservation.

The author is director, Soil and Water Conservation Research Division, Agricultural Research Service, Beltsville, Md.



Root development of 2-year-old guayule plants that soil conditions permitted to penetrate deeply in Anthony loam near Litchfield Park, Ariz., with no evidence of adverse effects of drought because plants had soil-moisture reservoir of 18 in. of stored water.



The difference in water-holding capacity of 2 typical soils.

whereas a crop with roots penetrating 6 feet in a clay loam would have a reservoir of 15 inches.

On bright, summer days, solar energy will effect evapotranspiration of 0.2-0.35 inch of water per day. Hence, the capacity of the soil-moisture reservoir is a key factor in drought hazard and irrigation management.

The inherent nature of the crop plant has much to do with the characteristics of the root system. For example, alfalfa roots are capable of penetrating much deeper than those of Ladino clover. Roots of bermudagrass proliferate far more extensively than those of potatoes. Thus, the nature of the rooting behavior of crops may delimit the capacity and effectiveness of a soil-moisture reservoir.

There is little that can be done to alter the inherent water-holding capacity of a unit mass of a given soil. Puddling may decrease the proportion of larger pore spaces holding water at the lower tensions and thereby decrease the amount of available water. Significant increases in organic matter may increase water-holding capacity. There are numerous characteristics of soils which either inhibit or prohibit potential root development and thereby limit the moisture reservoir:

Shallow soils overlying bedrock or indurated layers have a correspondingly shallow soil-moisture reservoir. Similarly, when roots are stopped at plow depth by the plowpan, "traffic pan," or claypan, the potential moisture reservoir in the subsoil is unavailable.

On many soils of the Atlantic Coastal Plain, roots of most crops will not penetrate the subsoil, because its acidity may record a pH of 3.8-4.2. Associated with soil acidity, there may occur toxic levels of aluminum and manganese in the subsoil that prevent root growth. Evidence also indicates that roots cannot penetrate a medium that is completely deficient in boron or calcium.

Soluble salts in the soil mass frequently limit penetration and proliferation of roots in the irrigated valleys of arid regions. In some arid areas, excess salts may have been leached away in times past, leaving high levels of exchangeable sodium. A sodic soil attracts calcium avidly and may actually remove it from growing root tips.

Since roots are living entities, their degree of growth is dependent upon the prevailing temperature of the soil. The prevalence of permafrost in some Alaskan valleys provides an extreme example of conditions which adversely affect root penetration.

Roots of most land plants must have ample oxygen to grow, and even to absorb water; so good soil aeration is important in making the soil-moisture reservoir effective. Poor drainage curbs the development of root systems through lack of aeration, and in arid regions fosters the accumulation of salines in the surface soil.

All conservation farming practices which help the deep penetration and spreading of the roots of crop, range, and forest plants contribute to improved management and beneficial use of that enormous portion of the Nation's water budget that is used in evapotranspiration. It also is evident that practices which affect the important infiltration of water into our soils influence the rate of recharge of our soil-moisture reservoirs.

WINDBREAKS: Reduce Evaporation—Hold Snow—Lessen Wind Erosion

By Elmer L. Worthington

A VISIT to Leonard J. Davis' ranch in the Dunn County Soil Conservation District is enough to show why more and more tree windbreaks are being planted every year in North Dakota and other Great Plains States. As Davis—past president of the North Dakota Stockmen's Association and a State Representative—will tell you of the single row, pattern-type field windbreaks he prefers:

"I think they are the answer in our country for controlling wind erosion, holding snow cover, and reducing evaporation from the hot dry winds."

"I think one of the big benefits is for the community to do this," Davis said in recommending that others with suitable soil be encouraged to plant pattern-type field windbreaks. "The more concentrated the area, the more benefit these windbreaks are. Such community-wide growing of windbreaks also could conceivably eliminate the danger to livestock and humans from severe blizzards."

The Davises were the first in their vicinity to plant single-row, pattern-type windbreaks, which also have added to the beauty of the landscape. People who have seen their trees remark enthusiastically that others with soil suitable for trees should follow their lead. North Dakota farmers and ranchers, through their soil conservation districts, already are planting about 2,500 miles of these protective field tree belts each year, not including farmstead-type plantings. North Dakota leads the Great Plains States in the rate of total windbreak planting.

In addition to the rangeland, Davis' 1,440-acre cattle ranch on the east edge of the Killdeer Mountains includes 640 acres of cropland adjacent to the headquarters. He planted windbreaks on 3 quarter-sections of this cropland in 1958, and planted the other quarter-section in the spring of 1963.

He farms on the contour in 10- and 15-rod strips, with the windbreaks planted 30 rods apart. All the trees were planted after the contouring was established. Species used included green ash, American elm, Siberian elm, Russian olive, caragana, buffaloberry, aromatic sumac, and others. By the fall of 1962, the Siberian elm were 20 feet tall, and fruit for wildlife food also was being produced by the windbreaks.

In the Great Plains, young windbreaks must be well cultivated and kept free of moisture-competing weeds and grasses if the trees are to develop satisfactorily.

"It's a job," Davis said, "but not a big one at all. We cultivated our trees the first year just like we did our corn. I understand now that many people are using 'over-the-row' cultivation with special implements the first year or so. The second year the hired man and I took a hoe, and in a half-day we took out what weeds the cultivators had missed. We had about 6 miles of single-row belts at that time."

Here is Davis' observation on the

The Davises and County Agent Bill Cockburn in 1962 by Siberian elm windbreak planted in 1958.

Davis' single-row, pattern-type field windbreaks between contour crop strips.

The author is woodland conservationist, Soil Conservation Service, Bismarck, N. Dak.

effectiveness of the windbreaks in holding snow on the cropland as a source of soil moisture for the next season's crops:

"In April of 1961, we got a foot of snow with strong winds. The snow was held on our fields, but the others in the neighborhood where they had summerfallow had bare fields. We measured snowdrifts over 200 feet wide on the down-wind side of our windbreak, and I think that is the reason the crop was so much better in the windbreak area than anywhere else in 1961. I also doubt very much if the snowdrifts delay seeding, as the drifts are quite shallow and extend over a wide area on the leeward side of the windbreak."

Davis noted, among their benefits, that wildlife is beginning to use his windbreaks. He has observed several coveys of Hungarian partridge in the area, some nesting in the protecting tree rows.

He also calculates that the windbreaks protect a zone 20 times the height of the trees from soil blowing.

Utah Irrigated Area Profits From Modern Soil-Water Management

By Clifford L. Merrill and W. Bradford Hatch

Wells Robison on field that was given minimum tillage.

THE Delta area in Utah is a working example of the value of modern conservation practices to a rural community. More efficient irrigated crop production and increased farm income are among the benefits realized through operation of the Delta Soil Conservation District since it was organized by local farmers in 1949.

Although early settlers found an abundance of deep, rock-free soil, with favorable surface slopes for irrigation, they were confronted with problems that very nearly defeated them at the start. The soils were formed in Lake Bonneville and delta deposits from the Sevier River, Soil development was under near-desert conditions, with annual rainfall of only 8 inches. Normally the soils are somewhat salty, and the movement of air and water through them is slow.

The irrigation water likewise is salty. About 60,000 acres receive irrigation water in the Delta area. If sufficient water doesn't move through the soil, the salt content of the soil increases as the water evaporates or is used by plants.

Farmers have, of necessity, become especially responsive to management practices that help solve their problems of salt, soil compaction, and drainage. They have found, for example, that open drains are more effective than tile drains in heavy soil. They know that grazing crop aftermath will cause excessive soil compaction unless the soil is dry; therefore, grazing is kept to a minimum. They favor alfalfa seed crops in their rotation, because they generally require less irrigation water than other crops. They have learned that deep, infrequent irrigations in young alfalfa stands encourage deep rooting. Such plants can better survive drought periods.

One problem in particular has plagued Delta area farmers for many years: How could they keep the soil open to allow free movement of air and water? This problem was brought to the attention of the Soil Conservation Service

Alfalfa roots on either end are normal and indicate favorable soil conditions. Four short-branching roots in center resulted from conditions inhibiting deep rooting. Top growth was proportional.

The authors are retired soil conservationist and work unit conservationist, respectively, Soil Conservation Service, Delta, Utah.

Large, compact clods, slick surface, and numerous cracks show poor structure of field newly broken out of greasewood by Duane Stanworth, before conservation treatment.

technician assigned to the Delta district when it was formed.

Karl Harris, Agriculture Research Service engineer stationed in Arizona, was asked by SCS to study the problem and make recommendations. His suggestions were used by soil conservation district board members and a few other farmers on a trial basis in 1953, and since have been widely accepted, with notable success, by the farmers in the area. His recommendations included:

(1) Plowing the land deep to eliminate tillage pans, and thereafter plowing it at varying depths to avoid forming a compacted layer; (2) leaving the soil rough-plowed to air out for several months before irrigating or working the land; (3) using one heavy 12-inch, pre-planting irrigation to moisten the soil deep and to leach salts below the root zone; (4) avoiding use of the disk or similar implements, because of their pulverizing and compacting effects on the soil; and (5) keeping the seedbed preparation to a minimum, to avoid packing the soil.

Harris also proposed attaching several implements in tandem on the tractor to accomplish seeding, furrowing, and other operations with a minimum number of trips over the field.

Wells Robison, member of the Delta district board for many years, and a leading proponent of these operating rules, said he used more irrigation water by following them, but that his crop returns were greater than the increased water costs.

"I saved labor and equipment time during my busiest seasons," he added. "Salt content of the soil was reduced. When I plow the land now, it can be done one or two gears faster than previously, and the soil is less cloddy than before. Minimum tillage has resulted in soil improvement."

Delta district farmers have found that soil tilth also can be improved by planting grass. Although grass plants are slower in opening the soil—requiring 3 years or more as compared to 1 or 2 years by mechanical tillage practices in stubborn, heavy soils—their effects last longer, because of the root growth. The most practicable approach is to loosen soil deep by mechanical means, and then maintain good tilth by minimum tillage and by growing grass with legumes and incorporating the maximum amount of "crop litter" and barnyard manure into the soil.

Minimum tillage decreases farming costs and improves soil tilth and production efficiency at the same time. In soils with proper soil structure, plants root deeper, have darker green color with more uniform stands, require less frequent irrigations, and respond more favorably to fertilization.

Stanworth in good barley crop on same field, on which he used minimum tillage and applied crop litter and barnyard manure. Note baled hay for other feed in background.

Southeastern States Move Out On Surface–Ground Water Problems

By J. A. Johnson

SURFACE WATER. — Quality and quantity depend upon watershed protection.

IT took a major drought in the early 1950's to change the traditional attitude in the Southeast that water was a common enemy to today's continuing studies and actions by the States to encourage orderly development and wise use of their surface and ground-water resources in the public interest.

As water users placed greater demands upon surface and ground-water supplies, uncertainties developed in their minds with respect to legal rights in the development and use of water. A water-problems committee, or group, was formed in each of the 11 Southeastern States, including Arkansas and Louisiana on the west and Kentucky and Virginia on the north.

On the basis of preliminary studies, these committees recommended that water policies be declared by legislative enactment, and that further study be authorized leading to sound implementation of those policies to encourage and guide orderly development, wise use, conservation, and protection of water resources, and to provide greater protection for private and public investments.

By the end of the fifties, legislatures in nine of the States had declared water policies. In Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Virginia, policies covered both surface and ground waters. Declarations of Arkansas and Louisiana applied only to surface waters. Further study of policy needs and recommendations were authorized by the legislatures of Alabama and Mississippi.

GROUND WATER. — Conservation watershed treatment also helps keep artesian water flowing from deep in the ground.

Generally speaking, the policy principles were directed toward beneficial use, conservation of water supplies, encouragement of seasonal storage, and restrictions upon or discouragement of waste and unreasonable use, with attention to water-quality problems.

Declared policies of Arkansas, Kentucky, Mississippi, North Carolina, and Virginia were implemented in varying degrees with respect to surface waters. Policies of Florida and Georgia were implemented with regard to both surface and ground waters. And the 1963 Tennessee Legislature passed a water withdrawal registration act which applies to withdrawals above a specified magnitude from any water source, except those from public water systems by their customers. In most cases, implementation has included creation of a

USABLE WATER.—Washing gravel for highway building is one of uncounted uses for surface and ground water.

The author is water program needs specialist, Soil Conservation Service. Spartanburg, S. C.

State agency, or other arrangement to set water-use policy in motion and give it direction.

All of the States authorized further study of problems and needs, data collection, continuing recommendations, or a combination of these, as a function of the administrative agency, legislative commission, or committee or other body.

In addition to the declarations of policy, protection of water quality through pollution abatement has been carried on in the States, and there is increasing recognition of the need to protect ground-water quality. For example, the 1963 Tennessee Legislature also broadened jurisdiction of the Stream Pollution Control Board to include ground water. Problems resulting from saltwater intrusion are receiving attention in Florida and other coastal States.

A number of States have enacted well-driller licensing acts, and several have legislation to control wild-flowing wells.

Particularly with respect to ground waters, implementation of water-use policy is not a simple matter. For one thing, most States do not now have sufficient data for a full understanding of the occurrence, extent, and nature of their ground-water supplies.

Ground-water problems are not easily recognized. A dry, muddy, or polluted surface stream is an open document; whereas most ground-water problems must be viewed between the covers of a book. Also, the full significance of a known problem, such as a falling ground-water level, for example, may not be readily apparent. The effects of development of ground waters of some areas upon the surface supplies, or vice versa, have not been determined.

Study and data collection by the designated agencies, now under way in a number of States, will help to answer these and many other questions. Use-registration facts and data gleaned from well-driller reports also may be helpful. River basin investigations can be a source of valuable data, especially with respect to existing uses and future requirements. Other State and several Federal agencies, including the Soil Conservation Service, have some data which can help shed light on the occurrence, development, replenishment, or management aspects of underground supplies and upon present uses and future needs.

Thus, needed facts are accumulating upon which sound legislative adjustment can be based. As need and public understanding warrant, each State can further clarify and strengthen its water-use rights for underground as well as surface waters. Further clarification and strengthening of water laws may be expected as needs, problems, and public understanding dictate.

Minnesota Farmers Develop Water For Recreation and Wildlife

By Hans G. Uhlig

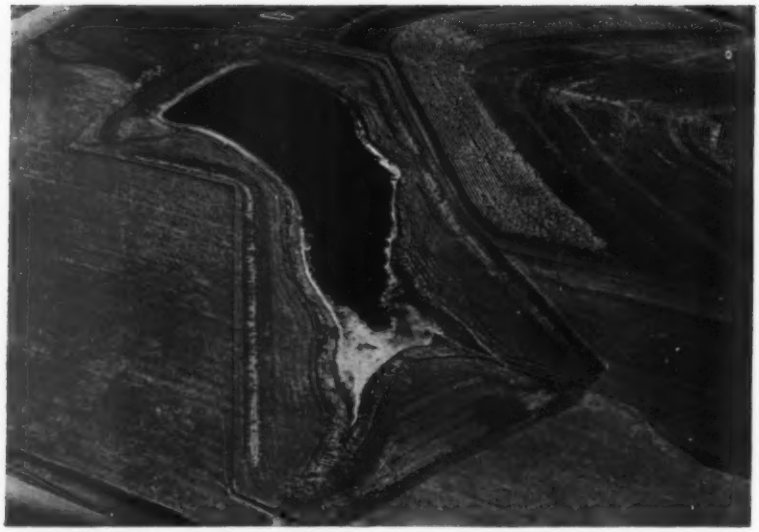
MINNESOTA farmers are becoming increasingly interested in recreation and wildlife as part of their farming business in rural community development. Many are asking for Soil Conservation Service technical help from the 82 soil and water conservation districts in the State in planning and installing wildlife improvement and other farm and watershed undertakings.

Records show, for example, that more than 3,000 acres were improved for wildlife during 1962 alone. In addition, farmers built 1,300 stockwater pits and ponds, bringing the total built in recent years to well over 7,000. These areas are of value to waterfowl and for related recreational purposes.

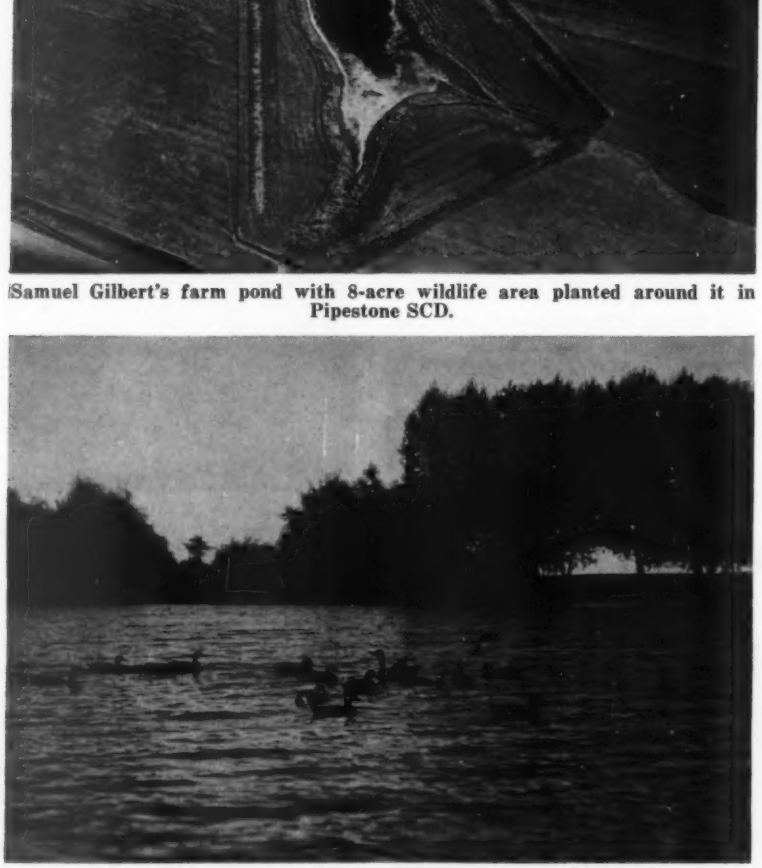
As an example, a total of 112 ducks were observed on 14 pits in the Wright Soil Conservation District during 7 observations in the spring of 1962. Five broods—30 ducklings—were produced on these pits. Pheasants, shore-birds, and deer also make use of the areas.

Amer Froysland, cooperator with the Becker Soil and Water Conservation District, is an avid sportsman. However, his interest includes development of wildlife areas as well as hunting and trapping. With planning and survey assistance from the SCS and cost-sharing from the Agricultural Conservation Program, Froysland has built two dams and is considering another. The author has counted 200 ducks making springtime use

The author is biologist, Soil Conservation Service, St. Paul, Minn.



Samuel Gilbert's farm pond with 8-acre wildlife area planted around it in Pipestone SCD.



Wild ducks on typical water conservation and recreation pond.

of Froysland's 25-acre wildlife area.

A rehabilitated slough on the Harry Jagow farm in Swift County is turning out to be a real wildlife-producing area. In 1959, Jagow dug a stockwatering pit, using the excavated material to dike a 4-acre slough and to build three islands. The first year, 3 pairs of blue-winged teal stayed and raised their broods. The second year, he had 7 pairs and last year 20 pairs. In addition to the ducks, the slough is being used by pheasants, mourning doves, and other wildlife.

"Wildlife use my stockwater pit almost as much as my horses and cattle do," Edward Haglund, a Koochiching district cooperator, says of the nesting mallard ducks.

Deer and many smaller wild animals also use the pit.

Users of Minnesota lakes likewise benefit from conservation planning and developments. Thus a lakeshore owner and a farmer worked together in solving gully erosion and a silting problem on Sugar Lake, northeast of Annandale. Lawrence Carlson and John Topfer asked help from the Wright County SCS Work Unit and installed a pipe drop inlet and two grass waterways. Topfer used the fill for a road for his farm operation, and Carlson uses it to reach his lakeshore property. Both recommend that more farmers and lakeshore owners work together dealing with such problems around recreationally important lakes.

"My detention dam serves many purposes," says Alfred Rucker of Oronoco of a structure planned with SCS technical help from Rochester. "It stopped the gully, reduced flood damages, and, with the surrounding area fenced out, it will make an excellent haven for all kinds of wildlife. In addition to this, in the winter it provides the community with a safe skating rink for recreation."

Tired of fighting a gully on his Waseca County farm, Cletus Hoehn put in a dam with a spillway and turned the gully into a stockwater and fish pond with about an acre of water surface. Hoehn and his neighbors now take bluegills weighing up to ¾ pound, and bass weighing 2 pounds or more from the pond.

The farm pond on the Orlan Mack farm in Brown County had a new use when Mack's relatives and friends gathered to hunt ducks. Shortly before the season opened, some 85 wild ducks were counted on the SCS-designed pond.

These examples of farmer participation in the wildlife and recreation movement point to the potential proportions of such developments in the future. There now are more than 45,000 soil conservation district cooperators in Minnesota, who control 10 million acres of farmland.

Steel Barrel Risers Cut Cost of Underground Irrigation System

By Leon R. Hubbard

RANCHER John Carpenter of Steptoe Valley in Nevada used a new "barrel" riser technique to save costs of an underground irrigation system that solves a tough water problem and doubles his hay output.

Making the best use of irrigation water is not a new problem for Carpenter and other cooperators of the White Pine Soil Conservation District. These lands are, in some cases, steeply sloping, with light textured, erosive soils.

"For many years," Carpenter says, "we used open ditches to bring water from a big spring to corrugated fields. These ditches didn't work very well, and we lost a lot of water and soil. It also took a lot of time to operate and maintain them.

"We got better use of our water when we installed a mile and a half of pipeline to get water from the spring to the edge of the fields, but we still lacked the kind of efficient water distribution we were after on the fields themselves. The answer was to install another underground pipeline, with risers that would get water onto each field with less waste and erosion.

"One day we talked things over on the ranch and came up with the idea of using 50-gallon barrels for risers. Risers could give better control of irrigation water and make water run more evenly over the fields; and the barrels, being cheaper than concrete, would hold down the cost of the new distribution system. When it came to designing the risers, though, we were getting over our heads; and we called on technicians of the Ely office of the Soil Conservation Service for a hand. We worked out a riser system that paid off from the start."

Carpenter first dug a 2-foot deep trench, 1,540 feet long, through the middle of his irrigated fields for a new underground pipeline. The trench was deep enough to permit the new pipeline and riser system to discharge the water from riser outlets at ground level. He has more than 40 feet of fall to work with in his pipe and riser system. Risers serve as a drop structure and outlet box, doing the same job as concrete drop structures.

Five 34-inch, 50-gallon steel barrels were made into risers. Eight-inch inlet and outlet holes were cut on opposite sides of each drum. Next, 15-inch squares were cut out of the top of each drum, and outlet gates were welded to it at right angles to the pipeline. Pipe and risers were coated with asphalt preservative to prevent rust.

Welding pipeline joints together, and the riser boxes to the pipeline, gave Carpenter a solidly built pipe system. The pipeline and barrel-

The author is work unit conservationist, Soil Conservation Service, Ely, Nev.

Carpenter stands beside old discharge pipe that fed water into open ditch at about 900 gallons a minute, with new barrel riser ready to be installed.

One of Carpenter's barrel risers in operation.

type risers eliminated a serious erosion hazard that existed with the old open ditch system. Cost of maintaining the risers and pipeline is low. The former open ditch area now can be farmed; and with the new riser-pipeline system, Carpenter can regulate his irrigation runs and get full use and better control of water.

The pipe and riser system cost about $1,200, with the Agricultural Conservation Program shouldering about half of the expense. Carpenter figures the investment has more than paid off, because of a large saving in water and maintenance cost. Three-fourths of the installation cost was saved by this ingenious use of barrel risers in place of the ordinary concrete risers.

Seepy-Pastures Springs

Pay Off For Ohio Farmers

By Adrian Achtermann

HOLMES County Soil and Water Conservation District farmers in Ohio are developing 40 springs a year to provide fresh water for livestock and transform rundown seepy areas to profitable pastures.

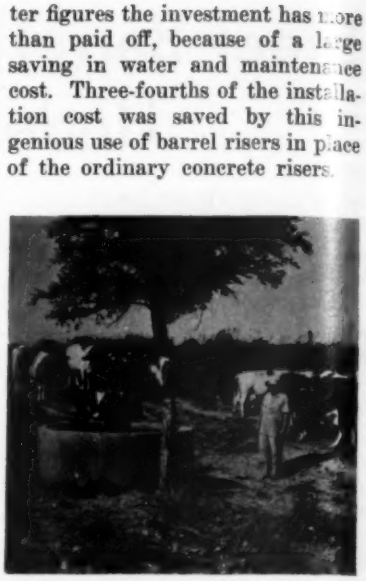
Four hundred seepy areas in the rolling countryside of the county have been developed to date. To expedite the practice, the district bought tank forms late in 1953 and are renting them to farmers.

Once rundown fields short on water have been renovated to provide succulent forage for cattle, because seepy areas have been developed to provide the water. These fields again are paying their way.

For the county as a whole, a total of 220,000 gallons a day of fresh water is available from the 400 spring developments, and may be credited with an estimated $96,000 increased income. Similar results can be obtained where beef cattle use spring water in fields isolated from the farm buildings and at one time of little value for pasture, because of their lack of water. Where springs can be developed in these fields, they are seeded to provide usable pasture.

Such a spring development can be expected to last 15 years. The increased return per spring, above the cost of construction, which averages about $250 over its lifetime, is figured at $3,600.

The first of these spring developments in Holmes County was on the farm of Frank Shutt, who has served as a member of the district board of supervisors for 15 years. The spring, developed in the fall of 1953, has provided a reliable source of water for Shutt's 30 cows.



FIRST.—Shutt's fenceline spring was developed 11 years ago.

"I saw the need for spring developments and urged the district to buy tank forms," Shutt reported. "My cows have been drinking fresh water for 10 years."

Shutt developed a little wet area that has provided an average daily supply of 550 gallons of water.

Floyd Jones, another Holmes County district supervisor, for 10 years, has installed six developments in different fields.

"Without water, these fields were useless during July, August, and September," he said. "Now, with a good fertilization program and the constant and fresh supply of water, I can pasture about a cow to each 1½ acres throughout the summer. This has greatly increased the size of my milk check."

Moses Hostetler recently installed the district's 400th spring devel-

ONE OF 6.—They have increased Jones' milk check.

The author is work unit conservationist, Soil Conservation Service, Millersburg, Ohio.

opment on his farm. A 15-acre field had been virtually abandoned by the previous owner. Realizing that a seepy area could be developed to provide water for livestock, Hostetler asked the Soil Conservation Service for help. Now that he has a reliable supply of water, he is reseeding the rundown pasture.

Rundown pastures, far from the buildings with no water, present a common problem in Holmes County, but it also has an abundance of these underground reservoirs of water. The Conservation Needs Inventory showed that about 40 percent of the springs had been developed for livestock water, and that there is a potential of nearly 330,000 gallons of additional water available from underground seeps. Development of this replenishing supply accordingly can yield an additional income of nearly $150,000 annually. The resulting renovation of pastures will produce an even greater return.

"Moisture Accounting" Method For Irrigation Tobacco Growers

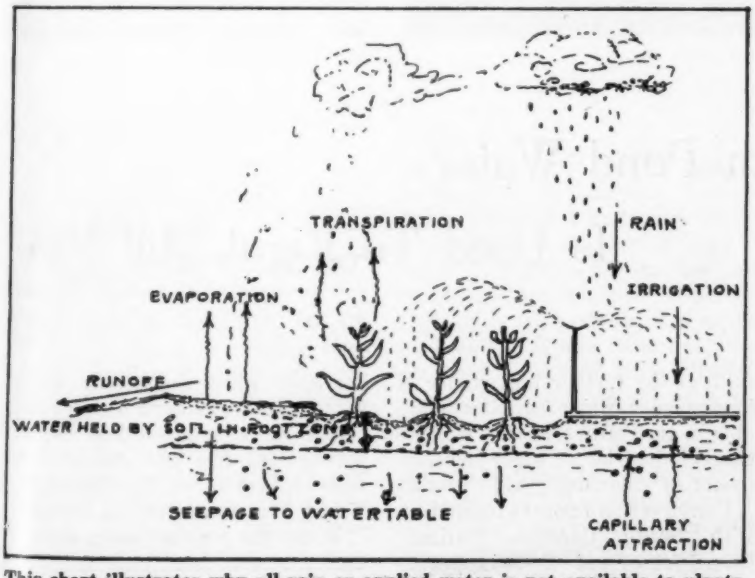
By Sam Cole

A "moisture accounting" method for determining when and how much to irrigate has been developed by the Soil Conservation Service working with Virginia tobacco farmers who began to supplement rainfall with irrigation about a dozen years ago.

Whether natural or artificially applied, water needs to be received in the soil before the moisture available to plants in the root zone is exhausted. The moisture accounting method shows what that moisture balance is and provides the irrigator with a guide as to when and how much to irrigate.

Checks with those using the new moisture accounting technique have shown that the quantity of water it indicates should be used is much more exact than the general recommendation, for example, of "light and frequent irrigation for tobacco," and that only a day or two have separated the "balance" method from the "judgment" method used by most. It generally has been found that when the moisture accounting record book shows a "zero balance"—or less than 1 day's supply of "available" water—the irrigator had applied water or was consulting weather forecasts and gathering other information by which to irrigate.

Charlotte County Farmer and SCS Work Unit Conservationist Norman Ramsey logs temperature with maximum-minimum (top) and conventional thermometers for evaluating daily moisture evaporation from tobacco land.



This chart illustrates why all rain or applied water is not available to plants. Irrigation should restore water in root zone to field capacity.

Customers and neighbors of W. A. Ellen at his crossroads store in Amelia County use his record book as a "book of facts." Allen himself says: "It's remarkable how my judgment and the figures agree. But it's a fact that it has sharpened my judgment about irrigation."

This is how the moisture accounting method for scheduling irrigation works:

All the equipment needed is a rain gage, a maximum-minimum thermometer (if daily average temperature information from a nearby weather station is not available), and the record book. The irrigator records average daily temperatures, the amount of rainfall or irrigation water applied, if

The author is engineer, Soil Conservation Service, Chase City, Va.

Irrigating bright tobacco on Foster Reynolds farm in Southside SCD.

Howard Hamlet (l.) and SCS Engineer Gail Ely in irrigated bright tobacco in Southside SCD, Mecklenburg Co., Va.

any, and an estimate of full sunshine for the area in increments of 0, 5, 9, 12, 15 hours each day.

The SCS technician measures the moisture content of the soil when it is at field capacity in the root zone; that is, when the soil contains in the voids all the water it can hold against the pull of gravity. Root zone depth of tobacco is considered to be 8 inches until it is about 3 weeks old, then 14 inches until the plant reaches maturity.

All of this water is not available to the plant, because surface tension on the soil particles will not release it completely. The plant never should reach the wilting point, as at this point the crop may suffer permanent damage. Therefore, the "available moisture" (approximately 50 percent of field capacity) is entered into the record book as the initial "deposit." This deposit is made 2 or 3 days after a soaking rainfall or an irrigation designed to wet the soil to field capacity.

Only measurable rainfall and irrigation are recorded as "deposits." Rainfall in excess of the amount to establish field capacity is considered lost, and dew and water rising from lower strata to the root zone by capillary action insignificant.

"Withdrawals" from the moisture account are made by consulting the "evapotranspiration chart." The irrigator, using this chart as a guide and, interpolating where necessary, estimates the daily consumptive use of the plant, computed by the Blaney-Criddle formula for tobacco at latitude 37°-03'. He subtracts this figure from the preceding day's balance and determines available water on hand. When the balance shows zero or insufficient quantity to carry through another day, he should irrigate.

Conservation Farm Pond Water Is Used To Fight Mill Fire

By H. H. Odell

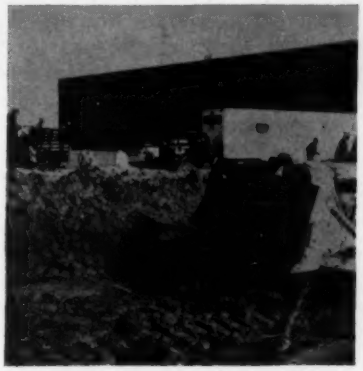
CONSERVATION farm ponds and small-watershed impoundments have in recent years become increasingly important sources of water for fighting fires in rural areas. The experience of one community, in Edgefield County, S. C., earlier this year is a reminder during Fire Prevention Week, October 6-12, of the further importance of having such water supplies available in agricultural areas which include industrial or other developments of community-wide benefit.

Conservation farmers teamed up with South Carolina National Guard forces and others in making agricultural water and equipment available when the public water supply was exhausted in the early stages of a multi-million dollar textile mill fire last January 26 near Johnston in the Savannah Valley Soil Conservation District.

When the regular water supply

The author is work unit conservationist, Soil Conservation Service, Edgefield, S. C.

was depleted by the mill's automatic sprinkler system, they turned to a 3-acre conservation farm pond a third of a mile away built several years ago by Rene Herlong. A National Guard bulldozer operated by Dewey Padgett of Edgefield threw up a temporary earth dam across the paved driveway into the



Top.—Textile mill that was on fire. L.—Farm pond that supplied water to put it out. R.—Irrigation pump Fred Holmes and brother lent firefighters. Bot. — Emergency reservoir being leveled after the fire.

plant. From here the fire trucks were able to pump the relayed water onto the flames and smoldering material in the building.

District Cooperators J. C. and Fred Holmes put the pump and some of the 8-inch portable main of their Soil Conservation Service-designed farm irrigation system to work keeping the temporary reservoir at the mill filled until the fire was extinguished. Another cooperator, Frank Berry, also provided some of the fittings from his nearby sprinkler system. Other farmers cooperated by supplying labor crews for around-the-clock cleanup activities, enabling the mill to resume partial production on January 30, and full production 1 week after the fire.

Plant Manager T. J. Meyer and Mayor E. Forrest Edwards of Johnston joined in crediting the community cooperation and the local soil and water conservation program for the major part they played in this emergency in Edgefield County's ridge section.

SOIL CONSERVATION IN INDIA. By M. S. V. Rama Rao. 1962. Indian Council of Agricultural Research. New Delhi. Rs 10.00.

My good friend M. S. V. Rama Rao, formerly engineer director of Soil Conservation in India, has written the first book on soil conservation to be written and published in India. I was especially interested in reviewing this book, not only because of my visit to India in 1960 but, also, because Rama Rao and I had many interesting discussions during some 3 weeks of field travel together and subsequent conferences.

Many of the projects cited in the book and situations described were observed by me in India. Therefore, I can vouch for the basic accurracy of the contents.

The book aims to provide all the essential information on the nature and causes of soil erosion, the necessity of soil conservation, principles and techniques of saving the soil and maintaining its productive capacity, and the part played by sciences like agronomy, forestry, hydrology, range management, etc., in controlling erosion.

As would be expected of an engineer, Rama Rao has given especial emphasis to the engineering phases of soil conservation. However, he has properly emphasized the necessity for biological methods of erosion control.

"Soil Conservation in India" is something of a mixture of the citation of problems and projects together with some rather detailed specifications for such engineering measures as bunds (terraces), gully control structures, etc. The citation of the problems and projects

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will have general educational value in India while the details will be helpful to agricultural workers.

Brief reference is made in the book to soil surveys and land capability classification as used in India. The principles developed in the United States for soil surveys have been adopted in large degree in India. Likewise, the basic concepts of soil conservation proven successful in the U.S. are proving successful in India. Of necessity, due to varying soil, climatic, economic, and social condition, there have been many adaptations to local conditions. But the concepts are still sound.

It must be realized that India has meager research and experience in dealing with many of its conservation problems. Therefore, it is gratifying that techniques developed in the U. S. are finding practical application in India. This has resulted from a variety of impacts.

Many Indian soil conservationists have visited and studied in America; soil conservationists from the Soil Conservation Service have served as technical advisers in India; and there has been a great deal of supplying of technical publications and handbooks.

In writing "Soil Conservation India," Rama Rao has made a very great contribution to his country.

—DONALD A. WILLIAMS

REPORT ON THE LANDS OF THE ARID REGION OF THE UNITED STATES. By John Wesley Powell. Edited by Wallace Stegner. 202 pp. 1962. The Belnap Press of Harvard University Press. Mass. $5.00.

Conservationists will find provocative reading in this publication first printed in 1878 but long out of print and available largely in public libraries. Edited by Dr. Wallace Stegner, professor of English at Stanford University, the book is presented in attractive format, with maps. The editor has added much instructive material in his introduction and footnotes.

Even with generalized scientific information, Powell interpreted the needs for western land settlement with a clairvoyance that has proved prophetic. Had his ideas been carried out, many of the disasters that occurred west of the 100th meridian could have been avoided.

He foresaw the risk of superimposing a subhumid eastern land settlement program in the arid West where drought is normal and where abundant rainfall is unusual. He recommended 80-acre homesteads for irrigated land, and more than 2,200 acres for grazing homesteads. He stormed the citadels of entrenched competitors by recommending the revision of the 160-acre homestead law, modification of the rectangular surveys in arid lands, reform of the General Land Office, transfer of the cadastral surveys to the Coast and Geodetic Survey, elimination of all contract surveying, and consolidation of the geological and geographical surveys of the West into one bureau under the Department of the Interior.

These revolutionary proposals received the same immature treatment too often given cold facts and logic. The western congressional block, cattlemen, and offended bureaucrats united against the recommendations. And Powell, eliminated by his own plans, was shifted over to the Smithsonian Institution. But he stubbornly continued his campaign for factual and scientific appraisal of western land settlement and development needs. He went on linking headwaters and lower waters, watershed and bottom land. And his ideas, largely ignored at that time, have become incorporated in much of modern conservation legislation.

This report also presents a classification of lands and vegetation in the various river basins in Utah. More than 80 years ago, Powell and a party estimated that only a little more than 2 percent of Utah's lands could be irrigated or dry farmed—a projection which was proved to be true.

—B. W. ALLRED